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Hankin, John

Ascertainment of machinery values and...

[New York]

[1917]

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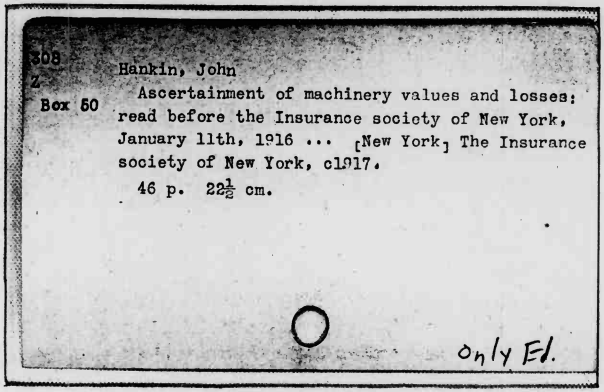

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Ascertainment of Machinery Values and Losses

READ BEFORE

The Insurance Society of New York

50

January 11th, 1916

BY

John Hankin
Of John Hankin & Brother

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Dec. 22, 1914 AET

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I wish to give credit at this time, to the friends I have consulted and to the several trade papers from which I have made notes and assimilated ideas that have been of material assistance in preparing this paper among which are principally the

"American Machinist"

"Power" "Iron Age"

and "Metal Worker"

INTRODUCTORY

Mr. President, Officers and Fellow Members of the Insurance Society of New York, I greet you. When Mr. Clough suggested that I undertake the task I am now attempting I was filled with fear and trepidation. I denied liability and demanded a non-waiver for non-fulfillment. This he refused to grant on the ground that it would be against the terms and conditions of his policy. He did, however, grant my request for a stipulation that my name be placed last on the schedule. This may appear strange to you, the present being the mid-season of these talks, but this agreement was made fifteen months ago. When asked previous to the opening of this season's work if I was prepared, I could only report progress without committing myself as to how slight that progress was. Mr. Clough met this, and a further request for more time in which to file my "Proof of Loss" (of speech) by fixing this date for my effort, and gentlemen, here I am. My request that I be the last speaker reminds me of the following conversation between two Irishmen:

"Sure, Mike, they does be telling me that in all the railway accidents the most people does be killed in the last car."

To this the other replied:

"Well, why don't they cut the last car off?"

Gentlemen, I trust there will be no regrets that the last car was not cut off tonight.

REPLACEMENT VALUES.

In this world of men and minds there should be many original ideas, but as long as there is no Thought Exchange or Board of Idea Underwriters for indexing and separating the new from the obsolete, and for the proper classification of ideas, then estimates and appraisals will be necessary.

No transaction between seller and buyer is satisfactory unless there is a mutual advantage from it. No business is or can be successful if the relation between it and its customer is not satisfactory. Essentials to success are respect for the property and rights of others. This applies to the appraising of machinery values as much as it does to the buying and selling of any commodity.

The production of foundry and machine shop products is the greatest industry in the United States and is an index of the amount of labor employed. The machinery building industry closely indicates existing or approaching conditions in all other industries, machinery being at the basis of all manufacture.

In approaching machinery values we are confronted with so many angles from which the unit must be considered that the subject becomes most perplexing and difficult.

First—Must be considered the character, quantity, quality, and accuracy of the machine's product.

Second—The market value of the materials of which the machine is made.

Third—The material from a workable standpoint must be considered, as brass, bronze, composition, or cast iron, are much freer and more economical working metals than malleable or wrought iron, cast or tool steel.

Fourth—The proportion of machined or finished parts must be considered apart from the unfinished.

Fifth—The design of the machine and its parts must be carefully considered. Especially does this apply to the machined parts, as all cylindrical parts, regardless of their composition, are more readily machined than is the same material in any other shape.

Sixth—The weight, bulk and manner of assembling and transporting the machine must also be considered.

Seventh—The quantity, size, weight and design of the various parts, determine the time required to assemble the complete machine. If the demand is such as to warrant the maker preparing drawings, patterns, dies, jigs, etc., for the manufacture of the machines in large quantities the cost is materially reduced. This is best illustrated by the selling price of an automobile by one of the large manufacturers.

For the purpose of this paper, machinery may be divided into two classes:

First—Foundry, blacksmith, boiler and sheet metal work requiring little or no machining.

Second—Machine shop work requiring one or all of the above classes as a basis on which expert workmanship will be necessary to produce a finished machine.

The replacement value of the first class can be reasonably fixed at a pound price ranging from 2½c. per pound and up, in some cases where the casting is very thin and difficult to cast, it may cost 25c. per pound, but the average foundry charge for best quality gray iron may be fixed at approximately 6c. per pound, the greater the bulk the lower the cost, after fixing the pound price and the total weight of the unit, the replacement value can be reached. To estimate the replacement value of the second class requires a familiarity with the cost of machining and assembling, and with the several characters of material and workmanship of which the particular machine is composed.

As an illustration:

> Cast iron foundry work requiring no machining or labor outside of the foundry has a value of 2½c. and up per pound, while if machine work is necessary the cost may easily exceed this many times.

It must also be considered whether the machine possesses only patented attachments or is patented as a whole, if it is of domestic or foreign make. If the latter, then must be considered the lower material and labor cost, plus transportation and duty, as against a higher domestic cost. As an instance of how a limited demand affects the selling price of machines, I want to cite an actual case of two patented machines, each weighing 12,000 pounds. Call them A and B.

Machine A with a shop cost of $576 sells at $2,300.

Machine B with a shop cost of $1,400 also sells at the same price.

Machine A is a heavy compact machine, occupying but thirty square feet of floor space, 80 per cent. of its value being in cast iron bulk, the balance or 20 per cent. being labor. The cost is divided as follows:

Material	$480
Labor	96
	$576

While this machine stands alone and is in a field by itself, yet the average demand for it in the past ten years is less than one machine per year, while the preparatory cost, such as drawings, patterns, special flasks, etc., is just as great as though the demand were one per week. In cases similar to the above, returns that will warrant the original investment are discouragingly slow, and the maker, as a matter of self-protection, must secure what to the uninitiated are apparently large and unreasonable profits.

Machine B, while not patented as a whole, possesses several patented attachments that give to the maker desired talking points. Contrary to Machine A, the field for B is large, but the competition is also large and very keen. Each maker believes that the patented features of his machine more than counterbalance those of his competitors. This machine contains many parts, moving at high speed, and occupies 100 square feet of floor space. Contrary to Machine A the material represents but 40 per cent. of its shop cost, the balance or 60 per cent. labor. The cost of B is made up as follows:

Material	$560
Labor	840
	$1,400

Again, the shop cost of the ordinary return tubular boiler is approximately as follows:

Material	Labor
2/3	1/3

while for steam engines, particularly the high speed class, it is the reverse:

Material	Labor
1/3	2/3

A most important item and one which sometimes proves to be the greatest proportion of a machine's replacement value to the user is the cost of marketing. This in itself on some machines represents many times its shop cost.

DEPRECIATED OR SOUND VALUE.

The highways and byways of arriving at sound or depreciated values are far more numerous and will arouse more adverse contention and opinions, and open up more side paths from the straight and narrow, than ever beset John Bunyon in his Pilgrim's Progress.

How great minds may vary in simple matters reminds me of a book published in 1882 by Brentano describing ninety-nine ways of serving boiled beef. To illustrate how contrary reasoning may be applied to fit the ends desired, I will cite as follows: An Irishman died, leaving a large family to shift for themselves; one of the boys secured employment with a second rate circus, and at the close of a poor season returned to his home looking rather the worse for wear. Meeting one of his father's intimate friends on the street he requested the loan of two dollars.

"Well, well, Danny, is that you? I hear you went away with a circus."

"I did, Mr. Murphy."

"Well, Danny, you don't look well fed."

"I am not well fed."

"And you don't look well dressed."

"No, I'm not well dressed; they didn't pay us what they agreed, so I have no money to buy clothes; that's why I want to borrow the two dollars. I want a pair of shoes."

"Well, Danny, heres the two, but remember, the rolling-stone gathers no moss."

The following year Danny again went away with a circus, returning home in the fall and again meeting Mr. Murphy, he accosted him with "Mr. Murphy, here are the two dollars you loaned me."

"Well, well, well, is that you Danny, they do be telling me you went away with a circus again."

"I did, Mr. Murphy."

"Well, you look well fed."

"Yes, they took good care of us."

"And you are well dressed."

"Yes, they paid us what they agreed, so I bought new clothes and have a little money in the bank."

"Well, well, Danny, that reminds me of the ould saying, 'that the wandering bee gathers the honey.' "

Depreciated value is influenced by so many causes, and in so many ways, that it is difficult to describe, even on a basis of ordinary wear and tear, it is rare to find two manufacturers of the same class of machinery who agree, differing on this item alone as much as 50 per cent. for five years' use. Very often two minds considering depreciation will reach widely different results, for the reason that one may view it only as a resale proposition. He sees it at the price it would bring in the second-hand market, where, so to speak, it has the information painted on it that it has been through a fire.

As a further instance of the different views as to values, I cite the action of the owner of a successful jobbing machine shop in northern New York. He refused to recognize such a thing as depreciation, and wishing to purchase additional machinery, journeyed to a nearby town and purchased a few machine tools, the age of which was more of an unknown quantity than that of Ann. The employees of the railroad over which it was shipped, not having the same insight as to values as the new owner, mistook it for junk, and when it arrived at its destination it *was* junk, and required the assistance of the court to clear the situation.

One manufacturer (having a reputation for excellent care and up-keep of his machinery), making among other things a line of paper bag machines, makes it a practice to renew a certain class of his machine tools every five years, believing that increase in quality and quantity of output, with greater economy of operation, plus the salvage secured for machines well maintained during five years of careful use, fully compensates him for doing so.

Another manufacturer has fixed the useful life of his machines at twenty years, and still another at forty, each believing that his particular class of machinery would warrant operation for that length of time.

This, however, can only be based on ordinary wear and tear, it being possible (examples of which will be mentioned later) for machines to become practically obsolete in less than five years.

On the other hand, as examples of longevity of some pieces of machinery there is in use today in the engine-room of a New Haven (Conn.) factory two horizontal steam engines of 45 and 28 horse-power, respectively, both of which were built about 1855, and with the exception stated below, have been in

constant use since their installation, the larger of the two, a Corliss engine built under the original Corliss patents, was installed in a lumber mill, where it passed through a fire undamaged. The present owner purchased it from the original buyer in 1865 for $50; in 1902 it passed through a second fire, and was then stored in a vacant lot for about one year, where it was visited by vandals (with ability to reduce a high value to scrap value), who carted away its brasses and removable parts. It was then repaired, missing and worn parts replaced and renewed at an expense of $300.

I also cite a Cornish pumping engine of unknown make in the Shipley Colliery Company's coal mine near Derby, England, which in 1912 had been in satisfactory operation over 100 years.

Depreciation, in importance has precedence over profits. The manner of reaching the percentage of depreciation and the extent properly chargeable to any unit or class of machinery is as variable as the machines themselves. This variation is further augmented by the many angles from which it is approached by men of different minds. Broadly, it may be stated that depreciation embodies the following:

Use

Abuse

Improvement in material, in design, in output, and in economy of operation of later and more modern types.

We are told "man that is born of woman is of few days and full of trouble."

Paraphrasing: "Machines that are made by man are of few days and full of depreciation."

It has been said that man is no sooner born than he starts hot-foot for the grave. The moment a machine is completed it starts on the road of obsolescence to obsoleteness, to its grave, "the scrap heap." Today we live, tomorrow we are scrap. "Monturi Salutanius."

Speaking a good word for the lowly, and that the very often despised scrap may be elevated to its proper social position, it is interesting to note that our federal government in 1912 created in the Department of the Navy the office of scrap expert, who estimates the salvage of metal from the scrap in the United States at nearly $60,000,000 yearly. The value of the scrap accumulated and sold by three railroads in covering a period of two years is as follows:

	N. Y. N. H. & H. R. R.		Penn. R. R.	N. Y. C. & H. R. R.
	1914	1915	1914	1915
Old metals.....			$780,000	
Locomotives and wood passenger cars sold "as is".	$784,912	$931,861	114,326	$2,000,000
Oil barrels.....			22,439	
Waste rubber.....			15,222	
Waste paper.....			19,211	
Total value.....	$784,912	$931,861	$951,198	$2,000,000

There are no hard and fast rules to guide us in the matter of depreciation regardless of how caused. The argument so often met, that a "sum equal to the amount usually charged off for depreciation, has been expended for maintenance and consequently offsets depreciation," is not applicable in all cases.

It is true that money expended to maintain a machine at highest efficiency tends to minimize depreciation, but an expenditure for repairs that when completed leaves the unit in an efficient, but patched condition, offsets but a small percentage of depreciation. Expenditure that increases the machine's output or economy of operation adds to the original investment, but does not offset depreciation, there being certain depreciation on practically all classes of machinery that cannot be compensated for, by any amount expended, that falls short of replacement.

Depreciation by reason of obsolescence, or by fatigue of metal, cannot be compensated for by maintenance. As proof that fatigue failure of metal is a factor in the life of machinery, will say that duplicate machines working for twenty years under like conditions have collapsed at similar points within a few weeks of each other, due to no other reason than metal fatigue. Power plants particularly depreciate from this cause. Many engine breakdowns and boiler explosions undoubtedly being due to it.

As an illustration that improvement in production is the cause of greater depreciation than ordinary wear and tear, consider yourself the owner of an unused automobile of any make.

Concede that it has not been exposed to outdoor atmosphere conditions since its purchase but is of the 1910 vintage. What is its value today? All due to being superseded by machines having improved features that relegate the unused machine to

a back seat. Electric generators might also be quoted as a radical illustration. Again, there is the distinction between used and abused machinery, it being possible for abuse to cause greater depreciation than ordinary wear and tear or that due to obsolescence.

One manufacturer, having in view cheaper help and increased output, will tolerate abuse of machines that would merit dismissal from another. Depreciation does not affect all machines equally, many high-speed machines having a replacement value no greater than a slow-speed machine, will depreciate more rapidly than a slower machine. As an illustration, compare a high-speed printing press, knitting or automatic screw machine with a slow but powerful stamping press or rolling mill. In the former the greater value lies in the rapidly moving parts created by skilled labor; in the second the value lies in the weight or bulk, the labor of cost per pound being very small when compared to the whole value. And since the slow moving or wearing parts are but a small portion of the whole in the latter or slower moving machine, the depreciation will be less than in that of the higher speed machine.

In many instances the depreciation is greater when the machine is at rest than when it is in motion. This may particularly apply to deep well pumps, where corrosion is greater, due to the settlement in the water of some active corrosive agent, which, because both water and pump are at rest, possesses greater corrosive energy on a smaller area than when the pump is in motion. Instances are known of new pump rods corroding while at rest to such an extent as to cause breakage of rod and suction pipe shortly after restarting.

The writer recalls a claim for a new metal lining for a dry room based chiefly on corrosion damage. It was conceded that there was a large loss by corrosion, due to atmospheric conditions or the difference between "the high temperature inside and the lower temperature outside," causing the atmosphere to condense on the metal and thus start corrosion, which had been quietly going on for years, or from the moment of its installation.

Steam power plants, especially, unless unusual care is taken when laying them up to prevent corrosion, will depreciate more rapidly at rest than in use. External corrosion in a boiler that is kept constantly in use and consequently hot is almost impossible, as any moisture brought in contact with same is immediately evaporated, while if shut down and permitted to cool corrosion

immediately starts at the point where the shell leaves the brickwork and at every point where soot, dust or any moisture holding substance has gathered. Again, corrosion does not affect all metals equally. This includes iron and steel, regardless of form and shape. This is particularly applicable to boilers, ammonia and water condensing coils. While it is an unsettled question as to the advantage that iron possesses over steel in this respect, both having their advocates, it is generally conceded that depreciation of steel is greater than that of iron under similar exposed conditions, depending on the purity of the metal and impurities in the water which vary with each locality.

Another factor in depreciating power plants is that of permitting greasy or oily returns to re-enter the boilers with the feed water. These added to the sediment or scale which very often gathers over the fire surface, prevent the water from absorbing the heat units, causing the metal to become overheated, blister and sag, thus creating a weak spot in the boiler, which, if not remedied, may result in explosion and serious loss. These conditions, while not so serious in other portions of the power plant, have an appreciable effect in hastening the depreciation and in decreasing the life of the plant as a whole.

Instances are known of oil or grease baking to the depth of about one-eighth of an inch, due to its entrance with the feed water. Blisters nine inches deep covering fifteen square feet of the shell have resulted from this cause, necessitating the replacement of the sheet at a considerable expense and inconvenience to the operation of the plant. Air receivers have been known to explode as a result of admission of oil or grease sufficient to coat the interior, which, having been brought to a temperature approximately 500° F., have ignited and exploded. Explosions of this character are assisted by the great air pressure in the tank. In one case the pressure was eight times the atmospheric pressure of 14.7 pounds, or 117.6 pounds gauge pressure.

Instances of oil igniting at 270° F. under a pressure of 65 atmospheres or 955.05 pounds gauge pressure would indicate the higher the pressure the lower the temperature of ignition.

Valves used under high pressure often depreciate rapidly from the erosive action of the steam, causing what the operating engineer terms wire drawing, or steam cut, and often making necessary the removal of the parts or the valve itself (depending on the type installed). If the latter course is necessary the expense of such removal might readily represent a considerable

percentage of the replacement value of that portion of the equipment.

Unexpected depreciation due to obsolescence may reduce the replacement value of a machine much more rapidly than would result from ordinary wear and tear. One of the best examples of this is a group of steam engines in a power plant of one of the Edison companies. The engines are large and well designed and are highly efficient. They are today as good as new, yet they are not used for the reason that the operating expenses of a turbine plant under their conditions are enough less to warrant abandoning the older engines rather than to operate them. At the time these engines were installed this condition was not foreseen.

A steam plant may in a similar manner become useless on account of the introduction of water power by long distance electric transmission. The failure of the natural gas fields in the Pittsburgh district rendered useless glass factories costing millions of dollars.

*The process of steel making following the Bessemer invention made necessary the abandonment of expensive furnaces and machinery equipment, the changes in the making and handling the product necessitating not only the creating of machinery of new and heavier design, but its rearrangement on new and modern lines to fit the changed conditions and to take advantage of the more economical methods of operation which were absolutely necessary if the manufacturer wished to remain in business.

By the introduction of high-speed steel, millions of dollars' worth of machine tools were made practically useless. Cheap steel changed the manufacture of rails, sheets and shapes making possible today that which had seemed impossible yesterday and making necessary radical alterations in some plants and the abandonment of others; all of which not only affected the machinery equipment, including foundations, pattern drawings, etc., but the very buildings in which they were contained. Many of these buildings were, for various reasons, incapable of alteration to suit the changed conditions.

An example that will be brought home to most of you is that of the famous "Fall River Line" side wheel steamers, "Pilgrim" and "Puritan," known 25 years ago as the "Queens of Long Island Sound."

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*Matheson, Ewing, M. Inst. C. E., The Depreciation of Factories, pp 46-47, London, 1910.

The "Pilgrim" was laid up after twenty and the "Puritan" after fifteen years' use, the owners considering that in view of the greater economy in coal consumption of propeller type of boats over the side wheelers it would be inexpedient to spend the $250,000 necessary to overhaul the machinery equipment regardless of the fact that their total replacement cost at this time is in excess of $2,500,000; in other words, the obsoleteness of 10 per cent. of their value makes it necessary to scrap the remaining 90 per cent.

Hundreds of examples could be cited of capital, the value of which has been destroyed by changes in the art in which it was invested, by the shifting of population, by the unexpected extinction of natural resources, or by other changes in conditions which were not foreseen.

Corrosion of Steel and Its Correction.

The following extracts are taken from a paper read at the College of Applied Science, Syracuse University, Syracuse, N. Y., December 17, 1913, by J. T. Hay, chief metallurgist and chemist of the Stark Rolling Mill Company, Canton, Ohio:

"Corrosion or the rapid rusting of iron and steel may be considered as an effect of the combined action of water and oxygen, or in a broad sense, of moisture and air.

Both air and water may contain elements which will stimulate or accelerate the corrosion. The purity of iron has a marked influence on the rapidity of corrosion. The quantity of impurities must not only be very minute, but those few elements which it is impossible to remove entirely must be absolutely homogeneously distributed."

As an illustration of the effects of corrosion on metals varying in composition the following is quoted from the *Metal Workers* of January 16, 1914:

Service Test of Copper Bearing Sheets.

"Results are published of a service test of sheets made by the G. Drouve Company, Bridgeport, Conn. The company states that in the autumn of 1912 it conducted an acid test of various rust-resisting sheets, and later made a comparative service test which was concluded in October, 1913, and which made a similar showing. Three trays or pans of uncoated black sheets were placed on the roof of a building on November 5, 1912, and were taken off the roof October 9, 1913. The losses by corrosion are indicated in the figures below:

	Material A
November 5, 1912	54 1/2 oz.
October 9, 1913	36 oz.
Loss	18 1/2 oz.
Percentage of loss	34%
	Material B
November 5, 1912	63 oz.
October 9, 1913	36 1/3 oz.
Loss	26 2/3 oz.
Percentage of loss	42 3/10%
	Material C
November 5, 1912	61 oz.
October 9, 1913	32 oz.
Loss	29 oz.
Percentage of loss	27 1/2%

"Pan A was made of copper-bearing sheet steel, while Pans B and C were of steel made in open-hearth furnace by processes aiming at a minute content of impurities.

"The analysis of the three steels are given in the following table:

	A per cent.	B per cent.	C per cent.
Carbon	0.13	0.025	0.025
Manganese	0.40	0.038	Trace
Sulphur	0.027	0.030	0.029
Phosphorous	0.004	0.005	0.004
Silicon	Trace	Trace	Trace
Copper	0.29	0.17	0.04

Iron is more sensitive and has the power of varying its crystallization or form of structure in a greater degree than any other metal. The manufacturers have learned that the whole art of producing corrosion-resistant metal consists of freeing it of its impurities and producing the type of crystallization desired. Because of the extreme sensitivity of iron great care must be used in its physical treatment. The strains produced in rolling, unless removed by careful annealing, will generate active corrosion. These strains are caused by excessive speed in rolling or by extreme pressure in breaking down the metal.

German silver is a composition or alloy metal of copper, nickel and zinc. Owing to the danger of undesirable crystallization in extreme heating it is cold rolled, an allowance being made of one-tenth of an inch reduction in thickness for each pass through the rolls. The pressure of the rolls so hardens the metal as to make it necessary to anneal between each pass and to pickle in order to remove the scale resulting from the annealing.

ASCERTAINMENT OF LOSS.

Judging from general recitals one hears from time to time as to the damage fires have done, one begins to realize that its possibilities are beyond even the most prolific imagination, which reminds me of the boy who was cautioned by his mother not to go swimming, returning home late one afternoon and being asked if he had been swimming, he replied, "No." His mother, looking at his stockings, asked the reason for their being inside out. Scratching his head and ruefully looking at the stockings to confirm what he already suspected, he said: "Well, mother, I must of done that climbing over the fence."

Cast iron is more susceptible to damage by unequal expansion and contraction than any other metal, fractures often occurring from the moment of manufacture by reason of being exposed to the atmosphere too quickly after the metal has been poured into the flask, or by exposing the piece unevenly; that is, leaving a portion of the casting protected by a layer of sand, permitting another part which is exposed to atmosphere to contract more rapidly than the protected part, thus causing a fracture, which is either ignored, filled with a plastic material called filler, welded, or as frequently occurs, is condemned to the scrap to be remelted.

We are told that there is no such a thing as cold, everything starting with heat, the difference being in the varying degree of heat. As an example, liquid air when placed on ice will immediately start to boil. Along this line all metals are hard, the difference being in their varying degree of hardness.

"It has lost its temper" is a statement often made regardless of whether the material is babbit, cast brass, copper, composition, alloy or gray iron castings, wrought iron, machine or tool steel, when as a matter of fact only the last named metal is capable of being tempered, while a certain degree of hardness may be applied by heat treatment, to all the other metals mentioned, except babbit, cast brass, copper or alloy, it is but a surface hardness, its trade name being "case hardened," and is in no sense construed by the trade as being tempered.

The usual way of tempering steel is to heat the article to proper temperature and then to plunge that part to be tempered

into cold water, removing it while a portion of the article retains sufficient heat to draw the temper to the point desired. This is indicated by the color it assumes, and when reached the article is submerged in cold water and allowed to remain until cold. The greater the length of time elapsing between its being heated and finally cooled in the water the lower its degree of hardness.

In order to effect this temper a high temperature will be necessary; any temperature that does not evaporate the lubricant or carbonize the paint or woodwork surrounding the tempered material will not effect the temper, except it be in very delicate springs or small keen edge tools, and then it is only a possibility rather than a probability.

The fixing of damage varies with each machine and its use. If the loss is by water and consequent corrosion only, then must be considered the quality of the metals composing the machine, their susceptibility to corrosion, and the process and labor necessary to remove same; if the machine has been in direct contact with flame or has been subjected to a high degree of heat, then must be ascertained to what extent. Of great assistance to reach a conclusion is to note the conditions of surrounding materials which are more susceptible to heat than the machine itself.

If the loss be heavy bulky machines, the susceptible parts should be carefully examined, which, as a rule, are the brass oil cups, the caps of which should be removed to ascertain if any lubricant remains, and if so, its condition, if any serious heat has affected that particular part of the machine the lubricant will have thinned and passed on to the bearing and evaporated. If the bearings are of babbit metal and have been subjected to a high temperature the metal will melt and flow out of the box; if there are any delicate springs, examine same to ascertain if temper still remains. While these parts are excellent guide posts as to the extent of the damage a total loss of any one or all would not necessarily mean a very material loss to the body of the machine or to the replacement cost. The claim is often made that a machine, by reason of having been heated and then suddenly cooled, has deflected from the original lines; in such cases a careful examination of the painted and lubricated parts should be made.

If the machine or any large part of same be of cast iron and has been subjected to a high degree of heat and then suddenly cooled by water, causing sudden contraction, fractures are liable to result, and should be searched for. Cast iron frames of light

design, cast iron pulleys, and engine fly wheels are especially liable to fracture, which usually takes place in the arms of the pulley or wheel.

As straws indicate the direction of the wind, so does the condition of materials in close proximity to each unit have a bearing on the measure of damage. For example, if the machines finish such as varnish, paint, etc., or if grease or any other substance used in manufacturing the machine's product or the lubricant used on the moving parts of the machine, such as bearings, gears, etc., that generally exudes at some point of the bearing or if present, can be found in the interior of the bearing or on the gear teeth of the machine (all of which consumes at a temperature very much lower than that which will seriously damage the machine) remains, it is evidence that the metal has not deflected from its original lines and consequently has not suffered a very serious loss. To assist in reaching a conclusion under these conditions the lowest approximate melting, boiling, evaporating, flashing, ignition, and carbonizing points in degrees of Fahrenheit of several materials common in the manufacturing world are given; the blank spaces will give individual opportunity to add data that future information and personal experience may give.

Oils, Etc., as Indicators of Damage.

FLASH TEST.

The flash point of an oil is the lowest temperature at which the vapors arising therefrom ignite without setting fire to the oil itself when a small test flame is quickly approached near its surface in a test cup and quickly removed. The flash point of lubricating oil is higher than the boiling point, while that of alcohol, benzine, kerosene, etc., is lower.

FIRE TEST.

The fire point of an oil is the lowest temperature at which the oil itself ignites from its vapors when a small test flame is quickly approached near its surface and quickly removed. Since the fire point is always above the flash point, the fire point value becomes of minor importance for this paper.

EVAPORATION.

Starts at a comparatively low temperature and increases proportionately, its maximum under normal conditions being greatest

at the boiling point. Fire damage would remove all traces of lubricant long before actual damage to the metal takes place.

APPROXIMATE BOILING AND FLASHING POINTS IN DEGREES OF FAHRENHEIT.

	BOILS	FLASHES
Alcohol	173	...
Benzine	176	...
Camphor oil	...	131
Cotton seed oil	...	338
Gasoline	158	...
Lard	...	464
Kerosene oil	302	110
Linseed oil	597	601
Lubricating oil, [light machine]	...	300
Lubricating oil, [heavy machine]	...	500
Olive oil	...	419
Oil of turpentine	315	95
Parafine	...	317
Petroleum	...	70
Sulphur	800	...
Tar	...	119
Whale oil	630	...
Wood spirits (methyl alcohol)	150	32

APPROXIMATE MELTING POINTS IN DEGREES OF FAHRENHEIT OF THE FOLLOWING SUBSTANCES.

	MELTS
Antimony	1150
Aluminum	1157
Alloy (lead 1 part, tin 1½)	334
Babbit metal	750
Beeswax	151
Bismuth	504
Brass, bronze, etc	1692
Copper	1929
Fusible plugs used in steam boilers	383
Glass	1832
Gold	1913
Iron, cast	1922
Iron, wrought	2732
Lard	94
Lead	618
Nickel	2600

	MELTS
Platinum	3110
Steel	2372
Silver	1733
Solder, half tin, half lead	370
Sprinkler head solder	165
Sulphur	239
Tallow	92
Tin	446
Type metal	700
Wax	142
Zinc	779

APPROXIMATE CARBONIZING AND IGNITION POINTS IN DEGREES OF FAHRENHEIT OF THE FOLLOWING SUBSTANCES.

	CARBONIZES	IGNITION
Coal mixed, small and lump:		
Anthracite	...	572
Bituminous	...	...
Coke	...	482
Charcoal	...	392
Lignite	...	302
Ink, Printers'	...	...
Japan on metal	...	...
Japan on wood	...	...
Leather belt	275	...
Leather rawhide	300	...
Paint on metal	...	...
Paint on wood	...	...
Rubber live	...	...
Rubber belt	...	...
Rollers, composition or printers'	...	...
Varnish on metal	...	...
Varnish on wood	...	...
Wood	...	...

Paint or varnish on metal or wood will blister even in summer temperature if the wood has not been properly dried and moisture removed, or if the first coat has not been properly dried or applied. The blister when opened by a knife point generally frees the cause of the blister, which usually proves to be sap from the wood or imperfectly dried first coat.

Blisters under these conditions do not indicate excessive temperature.

Electric Motors and Generators.

Electric motors and generators are easily damaged by water or high temperature, regardless of whether in direct contact with flames or not, the evidence being a disintegration of the insulation. This cannot always be assumed to have occurred to the fields and armature even though the insulation to the exterior wires is consumed, this condition very often existing when both fields and armature have escaped serious damage. Motors and generators of old make are more susceptible to water damage than are those of modern type, the superiority of which is due to improvements in the system of water-proofing or what is termed impregnating as a protection against moisture in any form. As a matter of fact, the modern motor or generator will stand contact with water even to the extent of being submerged for several hours, and yield to a reconditioning treatment, embodying baking and re-varnishing of the fields and armatures. As an instance will quote a street car electric equipment which through accident in handling fell from a Jersey City dock and was submerged for several days in the salt water of New York Bay, after being recovered was reconditioned by baking, cleaning and varnishing to a condition equal to that of new at an approximate cost of 25 per cent. of its replacement. Many other instances of electric motors located in the bottom of elevator wells or shafts that owing to their location have been quickly submerged by water used to extinguish the fire in which position and condition they have remained for days, later to be recovered and reconditioned by above process and at approximately the same rate of cost to its replacement value.

Ascertainment of loss may be reached by proportioning to the parts effected, according to the following approximate percentage of replacement cost:

Frame, base and bearings	18%
Armature, consisting of shaft, computator, etc.	34%
Fields	48%

Owing to the greater economic condition under which motors and generators are manufactured over that of the general run of electrical repair shops it is possible for conditions to arise (especially in the case of small motors), even where the frame is intact, to make inadvisable to attempt rewinding.

Rewinding, baking, varnishing, etc., of armature and fields may be approximately fixed at two-thirds of their replacement cost reached by proportioning as above.

Printing Press.

The writer recently assisted in the appraisal of an offset lithograph printing press valued at $5,000. It was claimed that there had been sufficient heat to warp the frame and cylinders, together with many delicate and expensive working parts to the extent of $2,400, which claim when submitted to the umpire was increased to $3,000. It was pointed out to the assured's appraiser and the umpire that a temperature necessary to warp or deflect either the cylinders or the frame would be far in excess of that required to injure the more sensitive parts. These were many, and not one showed the slightest evidence of fire damage.

Insured's attention was called to the condition of the varnish on the receiving and delivering boards, there being no evidence of exposure to any but normal conditions. This was further strengthened by the perfect condition (so far as fire damage was concerned) of the bristles on a revolving dusting brush; the oil in and around the bearings; the heavy grease on metal driving chain; the printer's ink in the fountain; the cheese cloth dampening rolls; the live rubber carrying belts; the live rubber rolls; the rubber blanket, and the engraved zinc plate.

It was called to their attention that at 240° F. rubber loses its elasticity, which it will not recover unless of better quality than the ordinary commercial rubber. At 300° F. it becomes viscous, and at 400° F it becomes pasty and will not again resume its original condition, all of which was ample evidence that not only had the press escaped any direct contact with flame, but had not been exposed to a degree of heat sufficient to injure the parts most susceptible to damage, any one of which would have shown unmistakable evidence of serious damage at one-fourth the temperature required to damage the frame or cylinders on which the large claim was based. Demonstrations and argument, however, proved of no avail, the umpire awarding a damage of $2,875. or $475. more than the assured's original claim.

This was so directly contrary to facts and conditions and on its face was such an unjust award that I requested the opportunity of making the repairs at the value fixed on same by myself, plus the additional cost of removing to our shop the press after reconditioning to be again taken down and reassembled in the premises to which the insured had by force of circumstances been compelled to move.

The cost was added to by our being compelled to buy new parts, which the assured claimed were lost or taken by employees

and held as hostage by them for moneys claimed to be due for services rendered. In view of all the circumstances, it was deemed advisable to comply with their demands and pay the amounts claimed for the parts in their custody, which after all did not secure all the parts needed, it being necessary in order to complete the press to purchase additional parts from the manufacturer before the press could be completely re-assembled and made ready for the final tests, which was made by accepting and filling an actual commercial lithographic order, the work being done in the presence of two expert printing-press machinists, two expert lithographers and their regular helpers, one expert press-room foreman, one representative of the manufarturers of the press, our own employees, the writer and the assured, the latter finally O. K'ing the press and its product.

The cost of reconditioning plus the two removals and one-half the cost of expert witnesses, but exclusive of cost of lost parts, amounted to $492.06. The total cost, including the replacing of parts for which the fire was in no way responsible, and the cost of expert witnesses, was $941.09.

An interesting sequel to this case is that the assured's appraiser, acting for his employers and with the full knowledge as to the limitation of parts replaced, purchased the press, and so far as we know is operating it to-day.

Sewing Machines.

In the case of a sewing machine, ascertain if the thread is still intact or consumed; if the needle, which is a good barometer of the damage suffered, has lost its temper, which can be readily ascertained by forcing it out of the straight line by either pencil or thumb-nail, then suddenly letting go—if it returns to its original position its temper is unaffected; ascertain if the tension or any other delicate spring connected with the machine has been affected. The leather belts and wood tops of power tables are good indicators of the heat through which they have passed; failure to blister the varnish or carbonize the wood indicating insufficient heat to injure the metal. The fact that the table-tops are a total loss does not indicate that the heads are in a similar condition. In cases where the heads are a total loss, there usually remains a salvage in parts to be reclaimed from the heads and in the cast-iron table-legs and transmittors that is far in excess of that of scrap value.

Copper Dies.

The writer was recently interested in ascertaining the loss to a quantity of copper dies, the contention being that the heat to which they had been subjected had softened or drawn their temper. The process of making these dies was to cold-punch the design through copper discs about one and one-quarter inches thick. It is well known that repeated operations, embodying heavy compression stress or hammering, compresses and hardens the softer composition of alloy metals. Therefore, the constant hammering or driving of the punch, which formed the design, into the soft copper, forced the metal into a more compact mass, creating a hardness greater than the larger body of the metal. If continued in, it would finally have caused the thin walls of the designs to crack. To avoid this the die under process was occasionally heated to a cherry red and then cooled or softened, thus restoring it to its original degree of hardness.

The fact that the manufacturer of these dies found it necessary to heat and anneal them in order to secure a satisfactory and perfect die, and did so with the full knowledge that the consequence of such heating caused no damage, offsets the contention of damage by any heat that does not fuse or distort the metal. This was demonstrated by reconditioning a quantity of the dies and subjecting them to a test, and comparing them with an unused die and with a copper blank not yet subjected to the process of manufacture.

Engraved Copper Printing Rolls.

The writer also assisted in the adjustment of a loss of copper rolls, the contention being similar to that of the above case: That the copper, having been brought to a high temperature and then suddenly chilled by water, had softened the metal so that it was reduced from a large, sound value to scrap.

To meet this contention two of the rolls, which had apparently suffered the most damage, were subjected to a surface-hardness test which exceeded the normal in both cases. The difference in the degree of hardness between the two was so great as to raise the contention that one had suffered a damage. To further meet this, a new roll was ordered from the manufacturer of the ones in question and this subjected to the same test.

It was found that the new roll was many points softer than either of the two reconditioned rolls, thus thoroughly disposing

of the question that the copper dies or rolls in either of these cases suffered loss by fire or water in any way, and demonstrating that brass or composition castings not deflected from their original lines will readily yield to reconditioning. Also that there is a difference in hardness between the outputs of daily mixtures regardless of their being made by the same formula, in the same foundry, by the same men and so far as they could control it, under the same conditions.

It is conceded that copper brought to cherry red and permitted to cool gradually in the air will be several points harder than if plunged into cold water; but if the article still retains its original shape and has not been fused at any point, it has not changed from its normal condition and is subject to restoration.

Brass and Composition or Alloy Castings.

The design of many brass castings is such as to require a core that is difficult to extract by tumbling or by the ordinary means of file and brush. In cases of this kind many brass foundries remove the casting from the flask while it still retains its high temperature and throw it into a barrel of water, the temperature of the casting being sufficiently high to generate a steam pressure in the damp core, causing an interior explosion of a minor order, effectively blowing out all of the core sand and cleaning the interior at the same time. This further disposes of the contention that brass, on being subjected to a high temperature and suddenly chilled with water, changes its texture as to affect its usefulness.

All metals, and especially alloy or composition metals, are affected not only by deviation in the mixture itself, but by the lack of any fixed time schedule for feeding the various fuels and metals into the furnace. Any variation in the temperature might readily be affected by the addition or omission in quantity of any of the combustible materials from which the heat is derived; the length of time permitted to remain in the flask after being poured influences the texture of the metal; again, the texture will be affected by difference in temperature of the furnace at the time the volatile metals are thrown into the crucible or cupola.

The point was lately raised that a large quantity of composition valves had been subjected to a sufficient heat to cause the composition in the valves themselves to change its texture. A temperature sufficiently high to give such results would distort the shape of the article and fuse the metal itself, in which case

a post mortem, rather than an estimate or appraisal, would be all that would be necessary.

Brass, bronze or composition castings, under certain conditions, pass through what is termed a "sweating process." In other words, if the casting is taken from the flask when only the surface has assumed a degree of hardness sufficient to retain its shape, the interior of the casting itself may be at the time practically in liquid or pasty form.

The sudden chilling of the exterior will result in the so-called sweating, which is caused by the exudation of the coarser and softer alloys (such as lead and tin), at the surface of the metal. Such is the meaning of the so-called "sweating." This in no way harms the casting, however, and can only occur when the interior of the metal itself still retains a pasty form, of a very high temperature. I repeat that any composition casting, where the outside surface of the metal was attacked first with heat sufficient to cause this result, would warp and deflect the material in such a manner as readily to convince even the layman that its only value was scrap.

A further contention was made that the discoloration of the exterior of the valves was in itself so great as to render them not only unsalable, but practically useless and consequently of scrap value. Further, it was contended that the method proposed to remove the discoloration was injurious to the metal of which the valves were composed, and therefore impracticable and out of the question. It was pointed out to them that competitors in a similar line of business, using to all intents and purposes practically the same metal, subjected their product to the same operation which it was proposed to apply, the purpose of which was to remove foundry and factory discoloration and to give the casting a clean and, in the opinion of the manufacturer, an improved appearance. That this argument might be carried home, a quantity of valves subjected to the greatest heat were placed under hydraulic test before being dissembled and treated to the reconditioning process, the test being duly witnessed and noted. After being reconditioned and reassembled they were again subjected to the same test, which showed no change in the structure or the pressure the material was capable of withstanding. The solution and process of reconditioning followed in this case is practically the same as that used in all brass, copper, nickel, silver and gold plating establishments throughout the world.

The ingredients and proportions are shown on page 38.

Rough Castings Or Bar Stock.

Rough grey iron castings or rough bar iron stock, on which no labor has been performed, will suffer little or no loss by smoke and water. Any loss by fire to the former, whether by fusing or cracking (both of which are usually discernable), while extreme fire damage to the latter (that does not fuse the metal), may deflect the bar from its straight lines. This is readily restored by restraightening at a small portion of its replacement value.

PREVENTION OF FURTHER LOSS.

Metal Stock.

Brass, copper, composition, alloy, gold, silver, gray iron castings or wrought and steel bar stock in the rough, on which no work beyond cleaning has been expended, suffer little or no loss by smoke and water. So secure are they against further loss as to make inexpedient any expense to preserve same.

This may also be said of brass, copper, composition, alloy, gold or silver castings in process where the polishing or plating finish it yet to be applied. The measure of damage is that represented by the small amount of additional labor to remove any discoloration that may have attached itself to the metal, which additional labor will be but a small portion of replacement. Any expense involved with a view of prevention of further loss on this character of stock will exceed the amount of any additional loss that can occur from smoke or water.

If the articles are completed and the finish is the base metal, machine-turned or highly polished, the extent of the damage will depend largely on its construction and the function of the part affected. Where various parts have been assembled the loss is greater than when the parts are finished but not assembled, for the reason that in addition to reconditioning of material, the labor of taking down and reassembling must be considered. Expense of applying preventative measures against further loss is warranted, unless reconditioning can be started within a short period after exposure to loss.

Please note that above remarks are confined to stock articles of brass, copper, bronze, composition or alloys, and do not include finished wrought iron or steel stock.

It is customary in the metal trades which make cheap brass goods to dip such products in a denatured alcohol and flake shellac to prevent tarnish. The proportions of the bath are 1 gallon to 1 ounce, respectively. By dissolving a greater or less amount of shellac in the alcohol a stronger or weaker solution is obtained, but it should be used weak in order to dry rapidly and give an invisible film on the surface of the brass.

Iron and Steel Bar Stock.

If rough and is to be either forged or machined, and on which no labor has been performed, little or no damage from smoke or water can result and the expense of preventive measures is not warranted. If in process and some machine work expended, yet still lacking the finishing process, a damage by way of increase to cost of production may readily occur. It is difficult, however, to imagine any loss under above conditions that could exceed 25 per cent. of reproduction cost. If completed and finish is of base metal, machined, with a high polish, the loss will be greater, depending on the design and function of the part affected by the rust, which, while greater than that on composition or alloy metals, it is difficult, as stated above, to imagine the conditions where the loss would be total. The expense of prevention of further loss to stock of this character is warranted. For articles that can be readily handled the following, copied from the *Iron Age*, is recommended for the removal of rust and will prevent loss by corrosion:

Removing Rust.—Articles attacked by rust can be conveniently cleaned by dipping them in a well-saturated solution of stannic chloride, 12 to 24 hours sufficing, according to the thickness of the rust. An excess of acid in the solution must be avoided. After the objects have been removed from the bath they must be rinsed with water, then with ammonia, and quickly dried. They are said then to resemble dead silver.

Iron and Steel Stock.

Cold-rolled or polished bar or sheet stock should be dried as soon as possible and coated with heavy oil, grease or compound, as best suited to conditions, as described on page 33.

Stove or similar hardware, bright or black, may be saved from further loss by first drying the article and then applying a coating of beeswax and benzine. This can be applied thinly. The benzine, quickly evaporating, leaves a thin film of transparent protecting coating on the metal. Another mixture is vaseline, or any good grease, thinned with gasoline to make a thin liquid, applied with a brush. If the articles are small they can be placed in a perforated can or wire basket and dipped in either of above mixtures, which should be thin enough to run freely, so that all slots and threads in tapped holes will be coated.

Protection against corrosion is most difficult in the case of quantities of small-size articles. A method which has been

giving first-rate results in the case of buckles, rings and harness fittings generally may help to solve this vexed question, is cheap varnish diluted to two or three times its volume with methylated spirits. On account of evaporation, the mixture is made up as required. The apparatus consists of two oil drums, each minus one end. An ordinary five-gallon drum, 11 inches in diameter, has ½-inch holes punched in the bottom and sides. The other drum may be of 7-gallon capacity, of 12-inch diameter, or a 10-gallon drum, which is larger still. The larger vessel is filled about one-quarter full, and the articles to be treated put in the smaller vessel. The perforated drum is lowered into the liquid, immersing the articles to be coated. Withdrawing the smaller vessel immediately, the major portion of the fluid drains back again in a minute or so. To finish draining and to harden the coating, the contents are then shot out on a wire draining surface, and in fifteen minutes are ready to shelve. The process is really a cheap and effective form of cold lacquering in bulk. The articles retain their condition for a long period of time, while the coating is not in the least obvious.

Machinery.

The first and most important thing to do is to remove all accessible moisture from the machine by wiping with cotton waste or cloth. If protected against the elements or seepage from upper floors, a heavy cylinder oil should be liberally applied by slushing, giving especial attention to all finished or bright surfaces. If exposed to the elements or seepage from upper floors, a heavy lubricating grease or compound should be liberally applied. These may be purchased from any dealer in machines, factory or engineers' supplies.

A compound in use for many years, and one that will resist atmosphere dampness, salt or fresh water, regardless of location or quantities, is made up as follows:

4 Parts Tallow,
1 Part White Lead,

the latter being stirred in the melted tallow. To remove, use either kerosene or turpentine, applied on cotton waste or wiping rag.

Electric Motors, Generators, Etc.

If protected against the elements and seepage from upper floors, possible further damage is of such a minor factor as not to warrant any further expense to prevent same. If, however,

exposed to the elements or dripping from upper floors, the units should be protected by being covered with tarpaulins or tar paper securely weighted down or tied to the units themselves.

Small Machine Tools.

To keep tools clean and bright, rub a little mercurial ointment over them, which will form a moisture-resisting coating. Mercurial ointment is also known as blue butter. It is somewhat poisonous. Another good mixture to keep tools from rusting is made by taking:

6 Parts Lard,
1 Part Rosin,

Heat these together slowly, till the rosin is all melted. Benzine is added in about the proportion of one pint of benzine to half a pint of lard-rosin mixture.

RESTORATION.

Restoration of cast iron, whether rough, in process or finished, is feasible in practically all cases, except when the metal has been distorted or cracked by heat, or by sudden and unequal cooling, the method of doing so varying according to size, intended use and finish. If the material is rough, on which no work has been expended, little or no damage can result, although it is possible for small articles to acquire a state of rust sufficient to add to the cost of the material at the time of damage. If the finish is to be plated, and even though a portion of the machine work has been performed, the damage may readily be less than if a machine or polished finish is intended, for the reason that the plating or finishing process would of itself remove evidence of rust. In other words, the same process and practically the same amount of labor would be required to finish, if not exposed to fire or water. Therefore, the additional labor caused by rust or discoloration adds but little if any to the manufacturing cost. Brass, bronze, copper or alloy composition, either rolled or cast, when not warped by heat or its design effected by being crushed, will readily yield to reconditioning, regardless of whether the article is in process or in a completed state.

If the article is stamped sheet metal and has not progressed too far toward completion, deflections from original lines may some times be removed by again passing the articles through the stamping press, other damage, such as abrasion and scratches, being removed by the process of grinding, polishing, plating and buffing, which would be necessary to bring the article to a finished state if not exposed to loss by fire.

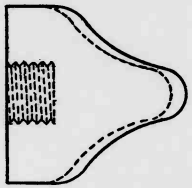
Restoration of manufacturing tools is usually a question of reconditioning and replacement of parts, and necessary skilled labor to fit same and recondition parts not damaged sufficiently to necessitate replacement.

Wood spinning chucks, solid or in parts, when not charred, even though warped and when placed on the lathe-head or spindle revolve out of true, regardless of any splitting that may take place, are in many cases capable of restoration, which is accomplished by turning the design further down on the same block. It is the aim of the practical chuck maker to allow ample stock

to permit of this being done, if for any reason it is desired, as by so doing there is a saving of 75 per cent. to the owner over the original cost.

It is possible that many chucks may have already been subject to this operation a sufficient number of times as to have reached the limit that a particular chuck will stand. It is safe to assume, however, that 75 per cent. of all wood chucks were originally made with this re-turning in view.

To better illustrate what I wish to convey, see sketch.



The plain lines indicate the original outlines of chuck, the dotted lines that of the chuck after reconditioning. The design of some chucks is such as to make this impossible. Again, it may have been done so many times as to have used up all the stock allowed for this purpose; but it will be found feasible in a large percentage of all wood chucks.

Even though the chucks show evidence of splitting or have actually parted, total loss does not necessarily follow, as in many cases restoration is possible at considerably less than the original cost.

Cleansing.

Copper, brass, zinc and the noble metals are cleaned by the suitable acids which act on them. Such cleaning solutions may be prepared for different metals as follows:

	Water	*Nitric*	*Sulphuric*	*Hydrochloric*
For copper and brass	100	50	100	2
Iron	100	3	8	2
Iron (cast)	100	3	12	3
Zinc	100	..	10	..
Silver	100	10	..	..

It is best to make two such solutions, one being reserved for a final dip, during which a strong action occurs upon the surface. As this becomes weaker it can be used for the first cleansing, accompanied by occasional rubbing with sand, etc., according to the nature of the object.

Lead, tin and pewter must not be placed in acid, but are cleaned by aid of caustic soda.

In cleansing, different metals usually require a somewhat different treatment. The surface of most metals, when clean, soon become coated with a film of oxide when exposed to the air, especially when the surface exposed is wet, and to avoid this it is necessary to see that they are thoroughly dried.

Before proceeding to cleanse the articles they are usually "trussed" (fastened) with copper wire, to avoid the necessity of handling them during the operation.

The process of using above is the same as the dipping acid referred to on page 38, the only difference being in the substitution of the solution desired in place of that described under the third operation, dipping acid.

Copper and Copper Alloy Cleansing Solution.

Caustic Potash 1 Pound,
Soft Water 1 Gallon,

Heat nearly to boiling in a cast-iron pot provided with a cover. Brush to remove any loosely adhering foreign matter, truss, and suspend for a time in the hot lye; usually a few minutes will suffice, if the article is not heavily lacquered. If any of its parts are joined with solder it should not be allowed to remain too long immersed, as the caustic liquid attacks solder and their solution blackens copper. On removing rinse thoroughly in running water. If the articles are much oxidized, pickle in a bath composed of:

1 Gallon of Water,
1 Pint of Sulphuric Acid,

until the darker portion is removed. Rinse in running water and dip in the following solution:

Soft Water 1 Gallon,
Cyanide of Potassium, 8 Ounces,

Remove from the bath and quickly go over every part with a brush and fine pumice stone powder moistened with the cyanide solution.

"Dipping Acid" for Brass, Bronze or Composition.

The following process (that referred to on page 29, will remove all discoloration and will brighten brass, bronze or composition, and is commonly referred to in electro-plating establishments as "Dipping Acid." The container must be a stoneware vessel (avoid jars with lead glazing) and located in a well-ventilated room, and when not in use protect it with a cover of stoneware or glass:

First—Boil in hot potash water of one pound of soda to each gallon of soft water.

Second—Dip and wash in cold running water.

Third—Dip for an instant in a solution of one part nitric acid and two parts oil of vitrol (sulphuric acid).

Fourth—Immediately dip and wash in cold running water.

Fifth—Dip in hot water.

Sixth—Dry in sawdust box.

Pickling Bath.

Cast iron requires to be placed in a cold acid solution for "pickle," to dissolve or loosen the oxide from its surface. The pickle may be prepared in a wooden tub or tank from either of the following formulae:

Sulphuric acid (oil of vitrol), ½ lb.
Water, 1 gal.

Cast-iron work immersed in this bath, from twenty minutes to one-half hour, will generally have its coating of oxide sufficiently loosened to be easily removed by means of a stiff brush, sand and water. When it is desired that the article should come out of the bath bright, instead of dull-black color which they present when pickled in the plain sulphuric acid bath, the following formula may be adopted:

Sulphuric acid, 1 lb.
Water, 1 gal.

Dissolve in the above 2 oz. of zinc, which may conveniently be applied in its granulated form. When dissolved, add ½ lb. nitric acid and mix well.

Removing Grease from Machinery Parts.

The following method has been substituted for the use of gasolene and other light oils, because of the scarcity of the latter:

Boil the parts in caustic soda-lye (1 lb. per gal. of water), then brush while the article is still hot. Caustic soda is recommended as better than ordinary soda, since it causes the fat or grease to dissolve more quickly.

LEATHER BELTING.

Steer hides, from which leather belts are made, after being removed from the animal and thoroughly washed, are placed in vats and treated to a solution of lime and water. This is for the purpose of loosening the hair so that it may be readily removed. Care must be taken not to expose the hide too long in this solution, there being danger of burning and depreciating its value for belt purposes.

After the removal of the hair the hides are placed in vats and submerged in water, where they are permitted to remain for a period of time, varying with their thickness, and later washed. This is for the purpose of removing all traces of the lime. After this has been done, the hides are placed in one to four solutions of a tanning liquor, progressing in strength, where they remain for four to five months. This is for the purpose of swelling the fiber and increasing its elasticity and strength. It is then dried, and becomes rough leather.

The hides are then trimmed, separating the shoulder, belly and tail parts from the back. The nearer the center of the back of the hide, the better the quality of the leather. These centers are soaked in water until soft. The flesh side is then shaved, after which they are layed on long tables, where they are scoured, with the grain or hair side up. They are then suspended and semi-dried, and later treated to a process termed "dubbing," which consists of an application of a composition of codfish oil and mutton tallow, the viscosity and consistancy of which is approximately that of vaseline. This is applied thoroughly to both sides. The stock is then hung up in a warm room to allow the grease to soak into the fibre.

While this explanation of the tanning process is brief, it is sufficient for the purpose of this paper, and is intended to show the liberal use of water in the process of tanning leather for belt and other purposes.

The leather is then placed under a severe strain in stretching frames, where it remains for about 24 hours, just under the breaking point. This part of the process requires great care, as too great a strain removes the elasticity of the fibre and makes

the leather unsuitable for belt purposes. It is essential that leather belts have a certain amount of elasticity, in the absence of which the belt will break and tear. The fact that leather belts possess this elasticity, and give and take according to the atmosphere, is an advantage claimed by leather-belt manufacturers over that of rubber and fabric belts. Its ability to give and take gives to leather belts in use a greater life than used belts that are permitted to be idle for an indefinite length of time.

To be serviceable, leather belts must possess a certain amount of oil or lubricant, in order to be pliable. This grease, when the belts are subject to a wetting, is washed out, moisture taking its place, which later evaporates, causing the leather to resume its original hardness. Its pliability and life can be restored by the above treatment.

The life of leather belts, that possessed any virtue previous to being wet and then dried, can be restored by the use of the above-described preparation of codfish oil and mutton tallow. If the belts have suffered repeated wettings and dryings, and have become exceedingly hard, an excellent treatment is to run the belt, at the rate of about ten feet per minute, through a tank filled with tanner's oil, which is thinner than cod oil and mutton tallow, and is heated to a temperature between 140 and 150 degrees. Care must be taken not to exceed the maximum temperature of 150 degrees F.

As an instance of leather-belt restoration, will cite the case of the sinking of a grain elevator possessing a large value in leather belts, which was submerged in New York for two weeks. When raised the belts were removed to the factory of a prominent belt manufacturer of New York City, where restoration took place, and later the same belts were again placed in service in the same elevator, in a condition equal to that of the day previous to sinking, at an approximate cost of 25 per cent. of the replacement value, plus a further cost of approximately 10 per cent. for replacing wastage due to tearing of laps while being separated, preparatory to restoration and reinstalling.

At this time it is worthy of note that salt water is more injurious to leather than fresh water.

To restore leather belts suffering from a wetting that has not been sufficient to separate the belt layers or laps, first thoroughly clean, removing all dirt, then apply castor or neatsfoot oil to both sides of the belt, using a rag or bristle brush, giving a light coat to the face and a heavier one to the back, spreading evenly. In

the event of the belt getting too much of either of the above, the belt will become too soft and will slip; but this is only a temporary annoyance and it will adjust itself after being in use a short time.

Leather belts that have become saturated with oil may be restored by a surface washing of ammonia, naphtha or gasoline.

A belt dressing that is good for leather belts is not good for rubber or fabric belts.

Machine oils, soap or rosin are injurious to belts and should not be used.

The grain side of leather belts is the hair side.

Extreme water damage only, to leather belts may be fixed at approximately 25 per cent. of the replace value, plus freight and cartage to any competent leather-belt manufacturer, and the added cost of approximately 10 per cent. for loss in length of belt, due to tearing where laps have to be forceably separated.

Leather Belting "Waterproofed."

Leather belts that have been cemented with waterproof cement and treated to a waterproofing process are not damaged by any exposure to wetting, regardless of how received, the loss from water only being limited to the cost of cleaning and applying a proper belt dressing and reinstallation, which, except under abnormal conditions, would be approximately 10 per cent. of its replacement value. Reference to bills will indicate if belts are waterproof. All waterproof belts are stamped with a steel die, Waterproof.

Rubber Belts.

Rubber belts are especially designed to withstand water, and consequently are impervious to damage from that cause. The gum rubber entering into their construction is very susceptible to damage by heat, which is difficult of restoration. Loss, if any, by heat can only be based on decreased length of useful life.

Fabric Belts.

What has been said of rubber belts largely applies to fabric belts, except that not all fabric belts are waterproof. Waterproof belts are guaranteed against exposure to all weather conditions, steam and acid fumes (except nitric acid), water in any quantities and a constant temperature of 100 to 150 degrees F, and intermittant temperature considerably in excess of those quoted.

ELECTRIC MOTORS AND GENERATORS.

Where carbonization has occurred, re-winding of the carbonized portions will be necessary, the loss varying with the extent of the carbonization, which, however, may effect each field separately, without necessarily damaging adjoining fields. While damage to the armature does not necessarily mean a corresponding damage to the fields, or vice versa, the construction of the armature is such as to make it difficult to carbonize one portion or segament without making complete re-winding of armature a necessity.

When the damage is confined to smoke and water only, reconditioning is not difficult, and is accomplished by a thorough cleaning, baking and, in extreme cases, re-shellacking or varnishing.

In cases where motors and generators have been subjected to immersion in salt or filthy water, an excellent method is to give them a thorough washing by the use of fresh water through a hose and under high pressure, after which give the units a thorough cleaning, baking and varnishing (see page 24).

The following extract from a letter by J. H. Bryan, of Dayton, Ohio, published by *The American Machinist*, in their issue of September 4, 1913, will be of interest at this time:

"CLEANING UP A FACTORY AFTER THE GREAT DAYTON FLOOD.

"The subject of this article is a large Dayton manufacturing concern, located along the banks of the Mad River, a tributary of the great Miami River.

"The high-water marks over the entire plant averaged 12 feet, submerging the power plant and some 200 motors. March 29 the waters receded, leaving in the various shops a deposit of 5,000 tons of slimy mud, that had the bulldog tenacity for clinging to things, in addition to an acid property that was very destructive of steel and iron finished work.

"In order to retain and give the shop organization employment, the whole force of 700 men were employed, without reduction in wages, to remove the muck from buildings and machinery and to make repairs incident to the flood. In the power plant a boiler and a small engine were soon got in readiness to operate the only dry motor in the works, as a generator to furnish power temporarily for cranes to transfer motors to a central point for drying.

"The program for drying motors and generators was as follows: Suitable horizontal steam-jacketed tanks were provided, with a table moved on rollers inside of the tank for loading purposes, and the field coils and armatures were placed in these tanks and subjected to a temperature of 170 degrees F. and 27 inches of vacuum for 48 consecutive hours. At the expiration of this time a large percentage of these parts were found O. K., and those parts that showed a ground were reheated. The large generators, with armatures built on crank-shafts of engines, were liberally supplied with steam coils, especially at the bottom of the field ring, and the whole of the generator and steam coils boxed in with dry lumber, as it was found that planking was far more satisfactory than metal, owing to the fact that the lumber would absorb moisture, while with a plate-steel oven the interior surfaces would continually run water on account of the low temperature.

"The generators were subject to a temperature of 140 degrees F. for 36 consecutive hours, and were then ready to be tested out. If no difficulties were experienced, it was fair to presume the generators were in good condition. However, in such cases it is well, before the generators are put in commission to carry full load, to run them light for five hours or more.

"The generators and motors were all dried out as noted above, and only two motors in the whole lot gave trouble in operation.

"While these important members were receiving attention, the machine tools and all the manufactured product were taken apart and scrupulously cleaned, as the mud, when dried and pulverized, was a good substitute for flour of emery."

CLASSIFICATION.

Drawings, Patterns, Dies, Etc.

Drawings, patterns (both master and working), moulds, forms, dies, jigs or templets, are closely allied to each other, and any depreciation in value by reason of imperfection in design, change in style, or increase in output of machines of similar character of later and more modern type, or unsalability of product, or from any cause whatsoever, effects all the above items equally.

In my judgment, the Pattern clause should include all drawings, and:

Moulder's Patterns
: of wood, iron, rubber or plaster paris.

Sheet Metal Workers'
: patterns and templets, wood, metal and paper.

Lighting Dome Manufacturers'
: designs, patterns and templets.

Embroidery Manufacturers'
: designs and patterns, for hand, power and automatic machines.

Clothing Manufacturers'
: original designs and patterns.

Pottery Manufacturers'
: wood and plaster paris patterns.

Paper Box Manufacturers'
: box-makers' wood forms.

Millinery Ornament Manufacturers'
: moulds and patterns.

Hat Manufacturers'
: wood and plaster hat blocks, wood flanges, spelter and aluminum dies, rubber and leather saddles.

Metal Spinners'
: so-called wood chucks, which, in my opinion, would be better named if called metal spinners' patterns.

Machine Shops'
: drawings, patterns, jigs and templets.

Dies—
: cutting, blanking, forming, holding, stamping and embossing, as used by the manufacturers of articles of leather, cloth, paper, buttons of all kinds, shoes, etc.; exclusive, however, of threading dies, such as are used for threading pipes, bolts, etc.

NOTES OF INTEREST.

To the average man it is inconceivable for iron or steel chips to actually burn as so much inflammable material, but nevertheless such is possible and such incidents are the part of positive record. The phenomena is explained by the fact that it can get rid of its heat and consequently gives signs of complete combustion. A large pile of chips took fire in the yard of a machine shop not long ago, and the fire was described by a witness as follows: "The chips had been put through a centrifugal oil separator, and therefore the small amount of oil remaining had nothing to do with the fire. It was a plain case of burning iron. The metal was so finely divided, and presented so much surface to the oxygen in proportion to the radiating surface of the pile that, once started by the heat from a nearby rubbish pile, the combustion proceeded exactly as in a pile of coal, only apparently at a more rapid rate. The chips when cooled were a dark blue. The pile sank about a third in height, and a lot of metal must have been oxidized to create so much heat."—*American Machinist.*

Tow (residue left when flax, hemp and jute fibres are put through cleaning process) will glimmer at 518 degrees F., and at a temperature slightly above this will burn.

When impregnated with oils, their temperature rises spontaneously when stored, and when this temperature approximates that given above they become very dangerous substances.

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